REMARKS

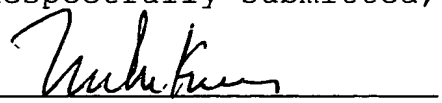
The specification has been amended to correct errors of a typographical and grammatical nature. Due to the excessive corrections thereto, applicants submit herewith a Substitute Specification, along with a marked-up copy of the original specification for the Examiner's convenience. Applicants submit that the substitute specification includes no new matter. Therefore, entry of the Substitute Specification is respectfully requested.

The claims and abstract have also been amended to more clearly describe the features of the present invention, and a copy of the marked up claims and abstract is also enclosed.

Entry of the preliminary amendments and examination of the application is respectfully requested.

To the extent necessary, applicant's petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (520.40496X00) and please credit any excess fees to such deposit account.

Respectfully submitted,



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SPECIFICATION

TITLE OF THE INVENTION

DISC DRIVING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a disc driving apparatus equipped with an optical pickup for reproducing or reproducing/recording of information on an optical disc, and, in particular, it relates to the disc driving apparatus, being suitable for so-called a CD-ROM drive, a DVD-ROM drive, and a DVD-RAM drive, etc.

As a laser light generation device and an optical disc read-out/write-in apparatus equipped with it, according to conventional art, as was described in, for example, Japanese Patent Laying-Open No. Hei 10-283650 (1998) (conventional art 1), there is known such a device, in which a thermally conductive sheet is disposed between a first heat radiation member and a second heat radiation member, wherein a contacting area is increased between the first heat radiation member and the second heat radiation member, comparing to the case where the both members are contacted with directly. Thereby, radiating heat, being generated in a semiconductor laser element as a heat-generating element, into the second heat radiation member effectively, so as to cool down the semiconductor laser element with high efficiency.

Also, as an optical pickup, according to the conventional art, as was described in , for example, Japanese Patent Laying-Open No. Hei 6-111357 (1994) (conventional art 2), there is also known such an optical pickup with using a prism made of plastic therein,

for providing an optical pickup that can detect an excellent signal without shifting of an optical axis within the plastic prism due to change of temperature, wherein a spacer for use of heat insulation is put between an optical system constructing the optical pickup and a silicon substrate on which a laser diode, as the heat generating element, is provided for emitting a laser light into the optical system, so as to form a layer of an air having low thermal conductivity, thereby enabling radiation of heat conducting from the laser diode into the silicon substrate.

However, in those conventional arts 1 and 2, there is no disclosure about deterioration on the lifetime of parts or elements, erroneous operation, or decrease in reproducing/recording accuracy, accompanying with non-uniform local temperature distribution, due to thermal interference between the adjacently disposed heat generating elements and/or heat generation of the heat-generating element. therefore, there is a possibility that, in a case where plural numbers of heat-generating elements are disposed neighboring wit each other, due to the thermal interference between the heat-generating elements, elements having small heat generation amount and/or ones of low heat-resistance or endurance are affected with the thermal influences by other heat-generating elements, thereby causing the deterioration on the lifetime of elements, the erroneous operation, and/or the decrease in reproducing/recording accuracy.

Namely, in general, within a disc drive or apparatus equipped with the optical pickup, there are mounted a laser diode generating heat when it conducts recording/reproduction operation, a laser driver circuit board, a high frequency module, and plural numbers of parts or elements, such as, a driver coil for use in an objective lens driver, etc., to be connected thermally, in a pickup housing made of metal, and heat generation of those heat-generating elements causes the local non-uniform temperature distribution within the pickup housing, thereby causing the thermal interference between those heat-generating elements. In particular,

accompanying with multi-functions of the disc drive apparatus, various disc drive apparatuses are developed being equipped with CD-R/RW function for recoding information on the disc, DVD-R/RW function for a disc of much larger recording capacity, and/or DVD-RAM function, etc. In those disc drive apparatuses, the detection light (i.e., a laser light beam) emitted from the laser diode provided within the optical pickup comes to be a very large in the output thereof, and also a large number of heat-generating elements must be disposed neighboring with each other closely, due to a demand of small-sizing thereof. Because of those heat-generating elements, the following problems are caused within the optical pickup:

(1) Thermal interference due to the neighboring disposition of the heat-generating elements;

(2) Thermal deformation due to the locally non-uniform temperature distribution;

(3) The deterioration on the lifetime of elements due to the heat; and

(4) The local rise-up of temperature within an inside of the apparatus due to heat radiation from the elements functioning as heat source, and erroneous operation or malfunction in a circuit system.

SUMMARY OF THE INVENTION

An object, according to the present invention, is to provide a disc driving apparatus, wherein the thermal interference is reduced between the heat-generating elements disposed neighboring with each other, in particular, in the optical pickup, so as to achieve the protection of the heat-generating elements from deterioration on the lifetime thereof, thereby having high reliability.

Another object, according to the present invention, is to provide a disc driving apparatus, wherein the thermal interference is reduced between the heat-generating elements disposed neighboring with each other, in particular, in the optical pickup, so as to enable protection of the heat-generating elements from deterioration on the lifetime thereof, and a shift of the detection light is made small, as well, so as to improve the accuracy in reproducing or reproducing/recording, thereby having high reliability and also being able to achieve reproducing or reproducing/recording of information with high definition.

A further other object, according to the present invention, is to provide a disc driving apparatus, wherein the thermal interference is reduced between the heat-generating elements disposed neighboring with each other, in particular, in the optical pickup, so as to enable protection of the heat-generating elements from deterioration on the lifetime thereof, and strength or rigidity of a pickup housing is secured, as well, so as to improve the accuracy in reproducing or reproducing/recording, thereby having high reliability and also being able to achieve reproducing or reproducing/recording of information with high definition.

First, according to the present invention, for accomplishing the above-mentioned objects, there is provided a disc driving apparatus, comprising: a housing of a disc drive; a rotation mechanism being received within said housing and for rotating a disc; an optical pickup mechanism being received within said housing and for reproducing or reproducing/recording of information on the disc, wherein: said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in radial direction of said disc; said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode emitting a detection light for reproducing or recording the information on said disc, a laser driver circuit board for controlling said laser diode, an objective lens driver for guiding the detection light emitted from to a predetermined

position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and said pickup housing mounts said laser diode and said laser driver circuit board with connecting them thermally, to be disposed in adjacent with each other, while providing a thermal separation portion for thermally separating between said laser diode and said laser driver circuit board.

Second, according to the present invention, for accomplishing the above-mentioned objects, there is also provided a disc driving apparatus, comprising: a housing of a disc drive; a rotation mechanism being received within said housing and for rotating a disc; an optical pickup mechanism being received within said housing and for reproducing or reproducing/recording of information on the disc, wherein: said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in radial direction of said disc; said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting a detection light for the use of a CD system, so as to reproduce or record the information on said disc, a laser diode for emitting a detection light for the use of DVD system, so as to reproduce or record the information on said disc, a laser driver circuit board for controlling said laser diode for the use of the CD system, an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and said pickup housing mounts said laser diode for the use of CD, said laser diode for the use of DVD, said laser driver circuit board and said objective lens driver, with connecting them thermally, wherein said laser diode for the use of CD and said laser driver circuit board are disposed in adjacent with each other, while providing a thermal separation portion for thermally separating between a side of said laser diodes for the

use of CD and DVD and a side of said laser driver circuit board and said objective lens driver.

Third, according to the present invention, for accomplishing the above-mentioned object, there is further provided a disc driving apparatus, comprising: a housing of a disc drive; a rotation mechanism being received within said housing and for rotating a disc; an optical pickup mechanism being received within said housing and for reproducing or reproducing/recording of information on the disc, wherein: said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in radial direction of said disc; said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting a detection light for the use of CD, so as to reproduce or record the information on said disc, a laser diode for emitting a detection light for the use of DVD, so as to reproduce or record the information on said disc, a laser driver circuit board for controlling said laser diode for the use of CD, an objective lens driver for guiding the detection light emitted to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and said pickup housing is defined by a sidewall formed all around thereof and a bottom wall, and said laser diodes for the use of CD and DVD, said laser driver circuit board and said objective lens driver are mounted therein, with thermally connecting thereamong, wherein said laser diode for the use of CD and said laser driver circuit board are disposed in adjacent with each other, while providing a thermal separation portion for thermally separating between a side of said laser diodes for the use of CD and DVD and a side of said laser driver circuit board and said objective lens driver.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a disc driving

apparatus, according to a first embodiment of the present invention;

Figs. 2(a) and 2(b) show a plane view and a cross-sectional view of an optical pickup in the disc driving apparatus mentioned above;

Figs. 3(a) and 3(b) show a plane view and a cross-sectional view of an optical pickup in the disc driving apparatus, according to a second embodiment of the present invention; and

Figs. 4(a) to 4(d) are views for explaining the condition of thermal flow-through in the disc driving apparatus mentioned above.

DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, embodiments according to the present invention will be fully explained by referring to the attached drawings. However, same reference numerals indicate the same elements or equivalents thereof in each of embodiments.

First, explanation will be given on a first embodiment according to the present invention, by referring to Figs. 1 to 3.

First of all, the total structure of the disc driving apparatus according to the present embodiment and the operation thereof will be explained by referring to Fig. 1. This Fig. 1 is an exploded perspective view of the disc driving apparatus according to the first embodiment of the present invention.

A disc driving apparatus 40, being a DVD-ROM apparatus corresponding to the CD-R/RW, comprises a disc driver housing 41 as the structure thereof, a disc loading mechanism for carrying a disc 1 into an inside of the disc driver housing 41 or out from

the disc driver housing 41, and a reproducing/recording mechanism for reproducing/recording information on the disc 1. This disc driving apparatus 40 is installed, for example, within a computer apparatus, to be used therein. Further, the present invention is applicable to within a certain extend of the structure, being common (or corresponding to) such as a CD-ROM drive, a DVD-RAM drive, etc.

The disc driver housing 41 comprises: sidewalls 42 in a rectangular shape on a plane view thereof, a mechanical base 7 formed within this sidewalls 42, a top cover for covering over an upper surface opening of the sidewalls 42, and a bottom cover 9 for covering a lower surface opening of the sidewalls 42, whereby defining an inner space being almost closed with them, so as to store elements accompanying hear-generation therein. Furthermore, since the disc driver housing 41 is thin in the thickness thereof, upon the demand of small-sizing of the apparatus, to be small in the inner space, therefore accompanying with the large capacity of the heat-generating elements, the thermal condition for the elements stored comes to be sever or strict. And, in a front panel 10 constructing a front surface of the sidewalls 42, there is formed a transportation or access opening 10a for carrying out/in a disc tray 11 therethrough.

The disc loading mechanism comprises: the disc tray 11, including a mounting portion 11a for mounting the disc thereon, a transportation or access driver mechanism for carrying the disc tray 11 into the disc driver housing 41 through the access opening 10a, so as to mount a spindle motor 2 on it, a disc clamper 3 for fixing the disc 1, being mounted with the spindle motor thereon, to a turn table of the spindle motor 2, and an up-down driver mechanism for moving a unit mechanical chassis 5, so as to fix the spindle motor 2 by means of a disc clamper 3. The access driver mechanism and the up-down driver mechanism is made up with a loading motor, a gear for transmitting driving force of a motor, and a driving force transmitting member, etc. Also, the disc clamper 3 is attached

on the top cover 8 at a predetermined position thereof.

The reproducing/recording mechanism comprises a rotation driver mechanism for rotating the disc 1, and an optical pickup mechanism for performing reproducing/recording of information on the rotating disc 1. In more detail thereof, it comprises the unit mechanical chassis 5, a unit holder, the spindle motor 2 mounted on the unit mechanical chassis 5, the optical pickup 4 mounted on the mechanical chassis 5, and the disc clamper 3 attached on the top cover 8. Further, the disc 1 is an information recording medium having a disc-like shape thereof.

The unit mechanical chassis 5 is formed in about a rectangular shape on the top plane view thereof, and it is attached on the unit holder (not shown in the figure) at each of the four corners thereof through elastic members 6a-6d, respectively. Further, the unit holder is inserted into the mechanical base 7 so as to be connected therewith. The elastic members 6a-6d are provided for the purpose of attenuation of vibration and/or shock transmitted from an outside of the apparatus to the unit mechanical chassis 5. And, the spindle motor 2 has a turn table for mounting the disc 1 thereon, and it rotates the disc 1 at a high revolution speed while holding it, together with the disc clamper 3, for the purpose of the reproducing/recording on the disc thereof. The disc clamper 3 is attached to the top cover 8 at a position just above the spindle motor 2.

Also, the optical pickup mechanism comprises the optical pickup 4 for reproducing information on the disc 1, which is mounted on the spindle motor, and for recording information thereon, and a radial direction driver mechanism for shifting or moving that optical pickup 4 in the radial direction of the disc 1.

Herein, an explanation will be given on the total operation of such disc driving apparatus 40. The operation of the disc driving apparatus 40 is made up with a disc loading operation of transporting the disc 1 which is carried into the disc drive housing 41, so as to

bring the disc 1 into a reproducible or recordable condition thereof, and a reproducing/recording operation for performing the reproducing/recording of the disc 1 which is loaded into.

The disc loading operation will be explained. First, the access driver mechanism of the disc loading mechanism is actuated, thereby to make the disc tray 11 projecting out from the access opening 10a (in the condition shown in the Fig. 1), and after the disc 1 is mounted on the mounting portion 11a, the access driver mechanism is actuated, again, to carry the disc tray 11 into an inside of the disc drive housing 41, thereby mounting it on the turn table of the spindle motor 2. Next, for fixing it by means of the disc clamper 3 which is provided on the surface of the top cover 8, opposing to the disc 1, the spindle motor 2, the optical pickup 4, and the unit mechanical chassis 5 holding those thereon are elevated by means of the up-down driver mechanism, as one unit.

Explaining the reproducing/recording operation, under the condition that the disc 1 is loaded into the disc drive housing 41 to be fixed with the spindle motor 2, the spindle motor 2 rotates at the predetermined revolution speed, thereby to rotate the disc 1. Under this condition, the reproducing and recording of information on the information on the disc by shifting or moving the optical pickup 4 provided on the unit mechanical chassis 5 in the radial direction of the disc 1.

Next, an explanation will be given on the details of the optical pickup 4 mentioned above, by referring to Figs. 2(a) and 2(b). The Figs. 2(a) and 2(b) show a plane view of the optical pickup in the disc driving apparatus shown in the Fig. 1 and the cross-section view thereof. Further, the Fig. 2(a) is the plane view, while the Fig. 2(b) the A-A cross-section view in the Fig. 2(a).

The optical pickup 4 comprises a pickup housing 24 for mounting each elements of the parts, which are necessary for the

reproducing/recording. This pickup housing 24 of a box type is made of metal material having good thermal conductivity, such as aluminum, magnesium, zinc, etc., and is made up with sidewalls 24a and a bottom wall 24b, to be formed in about a trapezoidal shape in the plane view thereof. On the sidewall 24a at one side (i.e., in the upper side in the Figs. 2(a) and 2(b)), is formed an opening 24c, through which a guide bar 21 penetrates, and two (2) slide bearings 22 are inserted with pressure into both end portions within this opening 24c. Also, on the sidewall 24a at the other side (i.e., in the lower side in the Figs. 2(a) and 2(b)), is formed a bearing 23 therewith as a unit, while projecting therefrom. And, the guide bar 21 extending in both sides for axially supporting the bearings 22, and the guide bar 21 extending in both sides for axially supporting the bearing 23 are provided on both side of the pickup housing 24. With this, the pickup housing 24 is movable in the radial direction of the disc 1 (in the horizontal direction in the Figs. 2(a) and 2(b)), thereby being supported freely slidable with a guiding axis of the guide bar 21.

Within an inside of the pickup housing 24 are provided parts or elements, such as, two (2) detector systems for the use of both CD and DVD, respectively. Namely, the pickup housing 24 comprises: a laser diode 27 (of wavelength: 780 nm) for the use of CD, a laser diode 28 (of wavelength: 650 nm) for the use of DVD, both as the detection light source, a prism 31 for guiding those detection lights upon the disc 1, a mirror 30, a collimator lens 32, a common photo-detector 34, for the use both of CD and DVD, for detecting the reflection light from the disc 1, a driver circuit board 29 for the laser diode 27 for the use of CD (hereinafter, only "for CD"), a driver circuit for the laser diode 28 for the use of DVD (hereinafter, only "for DVD"), a high frequency module, and a front monitor 35, etc., as well as an objective lens driver 26, which is equipped with an objective lens for determining the detection light on the disc 1 at a predetermined position accurately, etc.

For the purpose of dispositions of those parts or elements,

the pickup housing 24 is formed in box-like shape, wherein the laser diode 27 for CD, the laser diode 28 for DVD, the photo-detector 34 and so on are attached at cut-out portion (or an opening-like portion) provided on a sidewall 24a of the pickup housing 24, while other optical parts or elements are mounted on a bottom wall 24b within an inside of the pickup housing 24, and, further, the laser driver circuit board 29 on a lower surface of the bottom wall 24b.

Among the parts or elements mentioned above, being installed within the optical pickup 4, the followings accompany with heat generation thereof when the apparatus performs the reproducing/recording operation: the driver coil, which is used in the objective lens driver 26, the laser diode 27 for CD, the laser diode 28 for DVD, the laser driver circuit board 29, the high frequency module, etc., and those are mounted on the pickup housing 24 while being connected therewith thermally. With this, each of those heat-generating elements radiates the heat through transporting it into the pickup housing 24, when it generates the heat and rises up temperature thereof. Also, those heat-generating elements are disposed to be adjacent with each other in vicinity thereof, in the tendency of recent demands for small-sizing of the optical pickup 4. In particular, the laser diode 27 for CD and the laser driver circuit board 29 are disposed very close to each other. In addition, the laser diode 27 for CD increases up an output thereof remarkably, in particular when performing the recording operation, comparing to that when performing the reproducing, thereby increasing the heat generation with this; however, in general, it has a low heat-resistance temperature.

And, within the pickup housing 24 is provided a thermal separation portion at the position between the laser diode 27 for CD and the laser driver circuit board 29, for the purpose of thermally separating them. This thermal separation portion is extended, so that a side of the laser driver circuit board 29 and the objective lens driver 26 is separated from a side of the laser diode 27 for

CD and the laser diode 28 for DVD, thermally, and this is constructed with a slit portion and a recessed gutter formed in the pickup housing 24 and a heat separation member 25.

The heat separation member 25 is made of material, being smaller in thermal conductivity thereof than that of the pickup housing 24, such as a PPC resin (polyphenylene sulfide), polycarbonate, polystyrene, etc., and it is so provided, that it separates the laser diode 27 for CD thermally, from the pickup housing 24, which is positioned between the laser diode 27 for CD and the laser driver circuit board 29. In case of taking the strength or rigidity of the pickup housing 24 into the consideration, it is preferable to put in or mix a material of, such as glass filler, etc., into the material thereof, for rising up the rigidity thereof. This heat separation member 25 is filled up within an inside of the slit, which divides the bottom wall 24b into two, (2), and within the recessed gutter on the lower surface side of the sidewall 24a on an extended line from this slit portion, so as to be formed as one unit. The recessed gutter of this sidewall 24a is located in the middle between the laser diode 27 for CD and the laser driver circuit board 29. In this manner, the heat separation member 25 is provided within the pickup housing 24, for the purpose of heat separation between the laser diode 27 for CD, which emits a large amount of heat generation when recording information on the disc corresponding to the CD-R/RW, and the laser driver circuit board 29, for the use of CD within the housing. In other words, the heat separation portion 25 is provided, so that the pickup housing 24 is divided into two, (2), thermally, between the laser diode 27 for CD and the laser driver circuit board 29 for the use of CD.

Also, the heat separation member 25 is provided almost all over the entire width in both directions of the pickup housing 24, so as to separate the laser driver circuit board 29 and the objective lens driver 26 from the laser diode 27 for CD and the laser diode 28 for DVD, thermally. And, the prism 31, the mirror

30 and the optical detector 34 are positioned in the same side to the laser diode 27 for CD and the laser diode 28 for DVD.

As was mentioned in the above, the pickup housing 24 is made of such the metal material, aluminum, magnesium, zinc, etc., and the thermal conductivity is about 200 kcal/mh°C for aluminum, about 150 kcal/mh°C for magnesium, about 100 kcal/mh°C for zinc; therefore, the heat generated from the heat-generating elements 26 to 29 is preferably conducted to the pickup housing 24, to be radiated from the surface of the pickup housing 24. In this case, the thermal conductivity of the heat separation member 25 is about 0.2 kcal/mh°C since it is made of the resin material. With this, putting the heat separation member 25 between them, enables to make as about 0.001 times small as the thermal flow-through within the pickup housing 24. And, as apparent from the Fig. 2, with the structure of providing the heat separation member 25 on the bottom surface side within the pickup housing 24 and being covered on the side surface thereof with a member of the pickup housing 24, the housing and the heat separation member can be formed as one unit.

Further, it is also possible to make the space of the slit portion and the recessed gutter formed in the pickup housing 24 in a form of an air layer, but not filling up the space with the heat separation material 25. In this case, the thermal conductivity of the air is about 0.03 kcal/mh°C, being smaller than that of the material of resin group; therefore, it has a large effect on the heat separation, but the rigidity of the optical pickup 4 is lowered, then the heat separation member 25 will be needed to be provided if the rigidity is necessary for the optical pickup 4. Also, if the slit portion and the recessed gutter in the pickup housing 24 are formed in a fin-like structure (i.e., a concave and convex structure), in the case of being filled up with the air therein to form the air layer, it is possible to improve an effect of heat radiation into an air, remarkably, with the effect of heat separation.

With such the structure of the optical pickup 4 mentioned above, the heat generated from the laser diode 27 for CD use is radiated upon the lower side of the pickup housing 24, in the Figs. 2(a) and 2(b), and that from the laser driver circuit board 29 is radiated upon the upper side of the housing, in the Figs. 2(a) and 2(b). Therefore, it is possible to achieve an effective heat radiation, so that a uniform thermal distribution can be brought about over the pickup housing 24. In this case, on the lower side of the pickup housing 24 being separated by the heat separation member 25, there are disposed the laser diode 28 for DVD use, and so on, which also generates the heat when the apparatus operates, and also on the upper side of the housing, the objective lens driver 26, etc. However, since they do no have such the large amount of heat generation as the laser diode for CD use, and also since the distance between those elements is larger than that between the laser diode 27 for CD use and the laser driver circuit board 29, as well as, in the heat radiation volume by means of the pickup housing 24, therefore the thermal interference is smaller than that between the laser diode 27 for CD use and the laser diode driver circuit board 29 for the CD use.

In the present embodiment, a portion lies in the pickup housing 24 being formed as one unit, where the laser diode 27 for CD use and the laser diode 28 for DVD use, the prism 31, the mirror 30, the lens 33, the optical detector 34, etc., are disposed, and it is not divided into sections by means of the heat separation member 25, then the thermal deformation of the pickup housing 24 is small, therefore it is possible to make the relative positional shift and/or angular shift (a tilt of the element) between those elements small, thereby to improve the accuracy in the reproducing/recording operation.

According to the present embodiment, it is possible to prevent the thermal interference from occurring between the elements provided within the optical pickup 4, therefore it enables the effective use of the pickup housing 24 as the heat radiation member,

thereby protecting the laser diodes 27 and 28 from deterioration on the lifetime due to the heat. With this, it is possible to obtain a disc driving apparatus being highly reliable and able to achieve the high definition reproducing/recording.

Next, explanation will be given on a second embodiment according to the present invention, by referring to Figs. 3 and 4. The Figs. 3(a) and 3 (b) show a plane view and a cross-sectional view of an optical pickup in the disc driving apparatus according to the second embodiment, and in particular, the Fig. 3(a) the plane view and the Fig. 3(b) the B-B cross-section view in the Fig. 3(a). The Fig. 4 is a view for explaining about the condition of flow-through within the optical pickup mentioned above. However, in this second embodiment, an explanation will be omitted on a portions duplicating with those in the first embodiment. Also, in this second embodiment, the constituent elements commonly provided in the first embodiment achieve the same effects thereof.

The function of the optical pickup 4 is to reproduce or record information on the disc 1. For this reason, in the disc driving apparatus 40 (see the Fig. 1), there is provided a means for shifting or moving the optical pickup 4 to a predetermined position on the disc 1, and as a guide for it, in the side of the apparatus, for example, there is provided a main shaft guide bar 21 (the upper side in the Figs. 3(a) and 3(b)) and a secondary shaft guide bar (the lower side in the Figs. 3(a) and 3(b)). For supporting the pickup housing 24 to be freely slidable in the direction of the guide bars 21, two (2) pieces of slide bearings 22 (for the main shaft) are inserted with pressure onto the pickup housing 24, on the side of the main shaft guide bar 21, and on the side of the secondary shaft guide bar 21 is formed only one (1) piece of the slide bearing 23 with the housing as one unit.

Within an inside of the pickup housing 24, there are provided two (2) detection systems for the CD and the DVD, i.e., the parts or elements, such as, the laser diode 27 (of wavelength, 780 nm)

for the CD use and the laser diode 28 (of wavelength, 650 nm) for the DVD use as the detection light source, the mirror 30, the prism 31 and the collimator lens 32 for guiding those detection light upon the disc 1, the optical detector 34 commonly for use in the CD and DVD, for detecting the reflection light from the disc 1, the driver circuit board 29 for the laser diode 27 for CD, and the driver circuit and the high frequency module for the laser diode 28 for CD, and the objective lens driver 26 equipped with the objective lens for determining the detection light on the disc 1 at the predetermined potion accurately, etc. A mirror 30 is attached on an each upper surface of the laser diodes 27 and 28 for CD and DVD, so that the detection light emitted from each of the laser diodes 27 and 28 is polarized in an inner direction on the surface of the optical pickup 4. For positioning those parts or elements therein, the pickup housing 24 is formed into the box-like shape with the sidewall 24a and the bottom wall 24b, wherein the laser diode 27 for CD, the laser diode 28 for DVD, the optical detector 34, etc., are mounted on the bottom surface of the housing being attached from the bottom surface side thereof, while the other optical parts or elements are mounted within an inside of the housing.

With the present embodiment, the heat separation member 25 is provided in the pickup housing 24 for separating the laser diode 27 for CD, the laser diode 28 for DVD, the laser driver circuit board 29 and the objective lens driver 26 from the other, thermally within the inside of the housing, among those mounted elements accompanying heat generation therein when the apparatus operates. The pickup housing 24 is made of the metal material, such as aluminum, magnesium, zinc, etc. The heat separation member 25 is formed by using the PPC resin (polyphenylene sulfide), polycarbonate, polystyrene, etc. In case of taking the strength or rigidity of the pickup housing 24 into the consideration, it is preferable to put in or mix a material of, such as glass filler, etc., into the martial thereof, for rising up the rigidity thereof. The thermal conductivity is about 200 kcal/mh°C for aluminum, about 150

kcal/mh°C for magnesium, about 100 kcal/mh°C for zinc, and 0.2 kcal/mh°C for the material of resin group. Therefore, putting the heat separation members 25 enables to make as small as about 0.001 times the thermal flow-through within the pickup housing 24.

Further, it is also possible to separate them by making each of the heat separation members only in the form of a slit, thereby thermally separating them by an air layer. In this case, the thermal conductivity of the air is about 0.03 kcal/mh°C, being smaller than that of the material of resin group, therefore it has a large effect on the heat separation. However, since the rigidity of the optical pickup 4 is lowered, then the heat separation member 25 will be needed to be provided if the rigidity is necessary for the optical pickup 4. Also, if the slit portion and the recessed gutter in the pickup housing 24 are formed in a fin-like structure (i.e., a concave and convex structure), in the case of being filled up with the air therein to form the air layer, it is possible to improve an effect of heat radiation into an air, remarkably, with the effect of heat separation.

Also, as shown in the Fig. 3(b), the heat separation members 25 are provided from the bottom surface side of the pickup housing 24, while the side surface thereof is covered with the member of the housing; therefore, it is possible to form the pickup housing 24 and the heat separation member 25 together, as one unit rigidly. Further, from the consideration of separation from the heat source portion, such the structure may be applicable, that the heat generating-element is attached on the pickup portion as other element, and thereafter that portion is attached through the heat separation members 25.

In a CD hologram unit forming the laser diode 27 for CD and a light detector 34 for the CD system together as an unit, or in a DVD hologram unit forming the laser diode 28 for DVD and a light detector 34 for the DVD system together as an unit, the provision

of the heat separation member 25 between those elements enables protection thereof from the thermal interference between them, and further, since no shifting of the detection light occurs on the optical detector 34 as far as no deformation is caused in the hologram unit portion, even when the housing portion is deformed due to a partial deformation by the heat separation member 25, therefore it is possible to realize the optical pickup 4 having high reliability.

In the present embodiment, further, because of the structure of the box-like shape, wherein the laser diode 27 for CD, the laser diode 28 for DVD and the optical detector 34 are provided on the bottom wall of the pickup housing 24, thereby surrounding the optical pickup 4 by the side walls in every direction thereof, therefore it is possible to improve the rigidity of the pickup housing 24, remarkably. For example, improvements can be obtained on the rigidity of the pickup housing 24 against bent and/or twist, and on the vibration characteristics due to local deformation, or the like, and also relative positional shifting and/or angular shifting between the optical elements due to the deformation in the static pickup housing 24 can be suppressed.

According to those embodiment, it is possible to protect the elements from the thermal interference between them, thereby protecting those elements from deterioration on the lifetime thereof. With this, it is possible to provide the optical pickup 4 having high reliability. Also, an improvement can be obtained on the reliability with the disc driving apparatus, in which such the optical pickup is applied.

Next, by referring to Figs. 4(a) to 4(d), explanation will be given on the structure, for the heat flow-through (arrows in the figure indicate the heat flows within the optical pickup housing members) and for thermal separation within the pickup housing 24, with the functions and effects thereof. Herein, the explanation is given on the case, assuming that the heat-generating elements

within the optical pickup 4 are the laser diode 27 for CD, the laser diode for DVD, the laser driver circuit board 29 for the CD and the driver coil equipped with the objective lens driver 26, as shown in the figure.

Fig. 4(a) shows the thermal flow-through (the flow of heat within the optical pickup housing members) from the heat-generating elements when operating within the optical pickup 4, but having no thermal separation structure therein. In general, an output of the laser diode 27 or 28 comes to be very large when recording information on the disc 1, comparing to the case of reproducing information on the disc 1. In the case of the DVD-ROM corresponding to the CD-R/RW, the laser diode 28 for DVD is only for the use of reproducing, exclusively; however, the laser diode 27 for CD is used for both the recording/reproducing, therefore, the heat generation from the laser diode 27 is large, in particular when recording. Also, the laser driver circuit board 29 provided within the housing is electrically connected with the laser diode 27, and they should be disposed neighboring to each other by taking noises and unnecessary radiation into the consideration. For this reason, the thermal interference occurs due to the mutual heat generation between the laser diode 27 for CD and the laser driver circuit 19 for the CD, and that portion comes to be the condition of being saturated thermally. Thus, it results in the rise-up of temperature of a portion of the laser diode 27, thereby bringing about the deterioration of the lifetime of the laser diode 27 and/or malfunctions on the laser driver circuit board or each of the circuit boards provided with the apparatus. Also, the thermal interference occurs due to heat radiation from the laser diode 28 for DVD and the driver coil equipped within the objective lens driver 26, participating with the other heat-generating elements, and it causes the thermal deformation on the housing through thermal distribution within the pickup housing 24, etc. The thermal deformation of the housing brings about the relative optional shifting and the angular shifting, etc., between the optical elements, thereby causing deterioration on the optical

characteristics (i.e., the shifting of the optical axis, and the positional shifting of an optic point on the optical detector).

Fig. 4(b) shows a principal idea of the present invention, in which each of the heat-generating elements is separated within the inside of the optical pickup 4, and the heat separation members 25 are provided for separating those heat-generatiing elements, respectively. With those heat separation members 25, being made of the material being smaller in the thermal conductivity than that of the housing, the thermal separation can be obtained. Also, with determining the volume of the housing portion being defined by enclosing with the heat separation members 25, depending upon the heat generation amount of the heat-generating element, it is possible to bring the pickup housing 24 as a whole into the condition of being almost uniform in the thermal distribution therein. With this, the local heat distribution can be eliminated, so that the housing can be reduced down in temperature as a whole.

Fig. 4(c) shows a variation of the heat separation member 25 provided within the optical pickup 4. The heat separation member 25 is disposed in the present variation, so that the laser diode 27 for CD and the laser driver circuit board 29 for the CD are separated from each other. Also, this heat separation member 25 is further elongated, so as to separate the laser diode 28 for DVD from the objective lens driver 26, in the structure thereof. With such the structure of the present variation, as was mentioned in the above, the heat separation member 25 is provided for separating between the laser diode 27 for CD having the largest heat generation amount, and the laser driver circuit board 29 for the CD, thermally, thereby protecting them from the thermal interference therebetween, and the heat flow from the each element is detected in the direction opposite to the heat separation member 25, thereby enabling to use the pickup housing 24 as the heat radiation member effectively. In this case, the thermal interference between the laser diode 27 for CD and the laser diode 28 for DVD, or between the laser driver circuit board 29 for CD

and the objective lens driver 26 is small, from the positional relationships between the heat generation amount from the respective elements and the distance between them (or, the cross-section area through which the heat conducts).

Also, the structure of the variation mentioned herein is effective, in particular, in the case where it is applied to an optical system having the CD system or the DVD system, wherein the optical elements, such as, the laser diodes 27 and 28, the optical detector 34, the prism 31 for guiding detection light from the laser diode 27 or 28 onto the objective lens of the objective lens driver 26, so as to be irradiated upon the disc 1 at the predetermined position thereof, and for guiding the reflection light from the disc 1 back to the optical detector 34, the mirror 30, the lens 33, etc., are installed in the form of separate elements, respectively. This is because the deformation is difficult to be formed, when the thermal deformation is caused in the pickup housing 24 due to the heat radiation from the each heat-source element, or when the vibration characteristic (bent mode, twist mode, local deformation mode) is caused due to the rigidity of the portion of the pickup housing 24, since the portion where the optical elements are installed is formed as one unit (no provision of the heat separation member 25). If the material of the resin group or the like is used for the heat separation member 25, the stress accompanying with the deformation is concentrated on this heat separation member 25, thereby relieving the stress on the portion where the optical elements are attached in advance, and therefore, it has an effect to suppress the deformation.

Fig. 4(d) shows the C-C cross-section of the optical pickup 4 shown in the Fig. 4(c). As apparent from this figure, the laser diode 27 for CD is provided with a cut-out portion from the bottom surface of the portion of the pickup housing 24, so as to be disposed at the predetermined position, thereby to be attached to. The laser driver circuit board 29 for the CD is attached onto the bottom surface of the pickup housing 24. The heat separation member 25

is provided between those two (2) elements; however, according to the present variation, with provision of a groove-like cut-out on the bottom surface of the pickup housing 24, the heat separation member 25, being made of material being smaller in the thermal conductivity than that used for the housing, is inserted into this groove portion. Of course, it may be formed with the pickup housing 24 as one unit. Arrows shown in the figure indicate the heat flows from the heat-generating elements. Since the cross-section area of the housing portion between the elements (i.e., between the laser diode 27 for CD and the laser driver circuit board 29 for the CD use) comes to be small for the heat separation member 25, the heat amount flowing through this cross-section also comes down to be small, thereby enabling the thermal cut-off between the elements. As a result of this, it is possible to protect the elements from the thermal interference therebetween. Herein, the cross-section area is remained a little bit between the elements, but since it is for the forming as one unit, therefore it is also possible to completely cut-off by the heat separation member 25 between them.

In each of those embodiments mentioned above, the heat separation member(s) 25 is/are provided in a straight line-like manner; however, the heat separation member(s) 25 may be provided with a curved portion, a deleted portion therein, or may be in such the structure that the cross-section area is changed in a portion thereof.

According to each of those embodiments mentioned above, with the provision of the heat separation member(s) 25 within the optical pickup 4, it is possible to separate the elements, such as the laser diode 29 and the laser driver circuit board 29, etc., generating heat when reproducing information on the disc 1 or when recording the information on it, thermally within the pickup housing 24; therefore, it is possible to protect those elements 27 and 29 from the thermal interference therebetween. With this, each of those heat-generating elements 27 and 29, being disposed

to be adjacent to each other, is able to radiate the heat stably, without having the heat radiation effects from the other elements; therefore, it is possible to protect it from the deterioration on the lifetime thereof. Also, with provision of the heat separation member 25, by taking the heat generation amount of the heat-generating elements 26 to 29 and the heat radiation volume in the housing members into the consideration, it is possible to obtain the uniform change in temperature of the pickup housing 24, thereby enabling the protection of the pickup housing 24 from the thermal deformation due to the local temperature distribution thereon. As a result of this, the detection light emitted from the laser diode 27 or 28 is guided onto the disc 1, and it is prevented from the relative positional shift and/or the shift in inclination, etc., within the optical elements, such as, the prism, the mirror, the lens, etc., for guiding the reflection light from the disc 1 onto the optical detector 34. In the disc driving apparatus using such the optical pickup, it is possible to protect the circuits from the malfunction thereof, and also obtain an improvement on the reliability of the apparatus, thereby providing the disc driving apparatus with the high definition.

As was fully explained in the above, according to the present invention, it is possible to reduce the thermal interference between the heat-generating elements disposed to be adjacent to each other in the optical pickup, so as to prevent the heat-generating elements from being deteriorated in the lifetime thereof, thereby obtaining the disc driving apparatus having high reliability.

Also, according to the present invention, it is possible to reduce the thermal interference between the heat-generating elements disposed to be adjacent to each other in the optical pickup, so as to prevent the heat-generating elements from being deteriorated in the lifetime thereof, and also to make the shifting of the detection light small, so as to improve the accuracy in the operation of reproducing or reproducing/recording, thereby

obtaining the disc driving apparatus having high reliability and being capable of the high definition reproducing or reproducing/recording.

Further, according to the present invention, it is possible to reduce the thermal interference between the heat-generating elements disposed to be adjacent to each other in the optical pickup, so as to prevent the heat-generating elements from being deteriorated, in the lifetime thereof, and also to maintain the strength of the pickup housing, so as to improve the accuracy in the operation of reproducing or reproducing/recording, thereby obtaining the disc driving apparatus having high reliability and being capable of the high definition reproducing or reproducing/recording.

What is claimed is:

1. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism [being received] disposed within said housing [and] for rotating a disc;

an optical pickup mechanism [being received] disposed within said housing [and] for reproducing or reproducing/recording [of] information on the disc[,] wherein[:]

said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in a radial direction of said disc;

said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode emitting [a] detection light for reproducing or recording [the] information on said disc, a laser driver circuit board for controlling said laser diode, an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts[,] including a lens, a prism, a mirror [therein], and an optical detector for detecting said detection light; and

[said pickup housing mounts] said laser diode and said laser driver circuit board are mounted in thermal contact with [said pickup housing so as connecting them thermally,] to be disposed [in] adjacent [with] to each other, while providing a thermal separation portion for thermally separating [between] said laser diode and said laser driver circuit board.

2. A disc driving apparatus as defined in the claim 1, wherein said thermal separation portion comprises a dividing portion formed

with either one of a slit portion or a recess gutter, for dividing said pickup housing, disposed between said laser diode and said laser driver circuit board, and a heat separation member disposed in said dividing portion.

3. A disc driving apparatus as defined in the claim 2, wherein said pickup housing is made of metal material having good thermal conductivity, including aluminum, magnesium, zinc, and said thermal separation portion is formed by filling resin material into the separation portion of said pickup housing, thereby to form them in one body.

4. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism being received disposed within said housing and for rotating a disc;

an optical pickup mechanism being received disposed within said housing and for reproducing or reproducing/recording of information on the disc, wherein:

said optical pickup mechanism has an optical pickup and a driving mechanism for driving said optical pickup in a radial direction of said disc;

said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting a detection light for use with a CD, so as to reproduce or record the information on said disc, a laser diode for emitting a detection light for use with a DVD, so as to reproduce or record the information on said disc, a laser driver circuit board for controlling said laser diode for use with a CD, an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector,

optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and

said pickup housing mounts said laser diode for use with a CD, said laser diode for use with a DVD, said laser driver circuit board and said objective lens driver, are mounted in thermal contact with said pickup housing thermally, wherein said laser diode for use with a CD and said laser driver circuit board are disposed adjacent to each other, while providing and a thermal separation portion is provided for thermally separating between an area occupied by a side of said laser diodes for use with a CD and the DVD and an area occupied by a side of said laser driver circuit board and said objective lens driver within said pickup housing.

5. A disc driving apparatus as defined in the claim 4, wherein the prism and the mirror of said optical portions and said optical detector are disposed on a side being nearer to said laser diodes for use with a CD and the DVD than to said thermal separation portion.

6. A disc driving apparatus as defined in the claim 4, wherein said thermal separation portion is provided, so as to thermally separate either one of between said laser diode for use of the CD and said laser diode for use of the DVD, and between said laser driver circuit board and said objective lens driver, thermally.

7. A disc driving apparatus, comprising:

a housing of a disc drive;

a rotation mechanism being received disposed within said housing and for rotating a disc;

an optical pickup mechanism being received disposed within said housing and for reproducing or reproducing/recording of information on the disc, wherein:

said optical pickup mechanism has an optical pickup and

a driving mechanism for driving said optical pickup in a radial direction of said disc;

said optical pickup comprises a pickup housing made of metal, in which are mounted a laser diode for emitting a detection light for use with a CD, so as to reproduce or record the information on said disc, a laser diode for emitting a detection light for use with a DVD, so as to reproduce or record the information on said disc, a laser driver circuit board for controlling said laser diode for use with a CD, an objective lens driver for guiding the detection light emitted to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector, optical parts, including a lens, a prism, a mirror therein, and an optical detector for detecting said detection light; and

said pickup housing is defined by a sidewall formed all around the periphery thereof and a bottom wall, and said laser diodes for use with a CD and a DVD, said laser driver circuit board and said objective lens driver are mounted therein in thermal contact with said pickup housing, with thermally connecting thereamong, wherein said laser diode for use with a CD and said laser driver circuit board are disposed so as to be adjacent to each other, while providing and a thermal separation portion is provided for thermally separating an area occupied by between a side of said laser diodes for use with a CD and a DVD and an area occupied by a side of said laser driver circuit board within said pickup housing and said objective lens driven.

8. An optical pickup, comprising:

a laser diode for emitting a detection light, so as to reproduce or record information on a disc;

a laser driver circuit board for controlling said laser diode;

an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding

reflection light from said disc onto an optical detector;

optical parts, including a lens, a prism therein, and a mirror therein; and

an optical detector for detecting said detection light; and

a pickup housing made of metal material, in which said above-mentioned elements are mounted, wherein:

said pickup housing mounts said laser diode and said laser driver circuit board with connecting them thermally, to be disposed in adjacent with each other, while providing a thermal separation portion for thermally separating between said laser diode and said laser driver circuit board.

9. An optical pickup, comprising:

a laser diode for emitting a detection light, so as to reproduce or record information on a disc;

a laser driver circuit board for controlling said laser diode;

an objective lens driver for guiding the detection light emitted from to a predetermined position on said disc and for guiding reflection light from said disc onto an optical detector;

optical parts, including a lens, a prism therein, and a mirror therein; and

an optical detector for detecting said detection light; and

a pickup housing made of metal material, in which said

above-mentioned elements are mounted; wherein:

said pickup housing mounts said laser diode for use with a CD, said laser diode for use with a DVD, said laser driver circuit board and said objective lens driver are mounted in thermal contact with said pickup housing thermally, wherein said laser diode for use with a CD and said laser driver circuit board are disposed adjacent to each other, while providing and a thermal separation portion is provided for thermally separating between an area occupied by a side of said laser diodes for use with a CD and an area occupied by the DVD and a side of said laser driver circuit board and said objective lens driver.

ABSTRACT OF DISCLOSURE

In a disc driving apparatus, wherein a laser diode (27) and a laser driver circuit board (29) are mounted on a pickup housing (24), being connected with thermally and disposed adjacent with each other, and a heat separation member (25) is provided between the laser diode (27) and the laser driver circuit board (29) for thermal separation therebetween, thereby reducing the thermal interference between the heat-generating elements disposed to be adjacent in the optical pickup, so as to protect the heat-generating elements from being deteriorated on lifetime thereof, as well as to improve the reliability thereof.